(12) UK Patent Application (19) GB (11) 2 328 469 (13) A

(43) Date of A Publication 24.02.1999

(21) Application No 9717719.0

(22) Date of Filing 22.08.1997

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(51) INT CL[6]
B63B 35/44 , E02B 17/02

(52) UK CL (Edition Q)
E1H HB HEA H601 H603 H606
B7A AAAQ

(56) Documents Cited
US 3717001 A

(58) Field of Search
UK CL (Edition P) B7A AAAQ AER , B7V VAA V103 , E1H HB HCA HEA HEF
INT CL[6] B63B 35/44 , E02B 17/02
Online:WPI,EPODOC,PAJ

(54) Abstract Title
Self installing reusable fixed platforms

(57) A platform assembly comprising i) one or more legs adapted to carry and support a deck assembly, the lowermost in use end of each leg incorporating a mud mat, ii) one or more buoyancy elements, each buoyancy elements being able to be ballasted or deballasted and associated with a respective one of the legs; and wherein the buoyancy elements are adapted to be independently moveable up and down said respective legs and also independently moveable with respect to the deck assembly.

In this arrangement the buoyancy units can be utilised as a composite hull for transit as well as acting as gravity foundations.

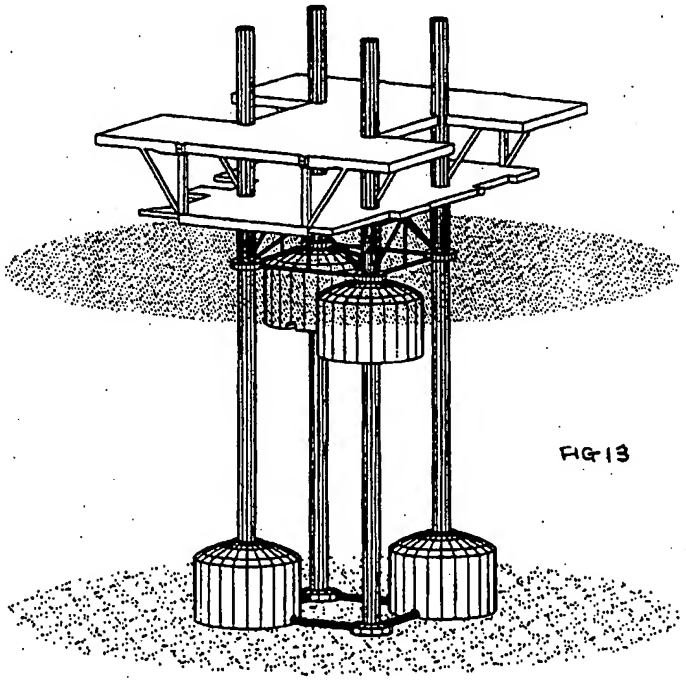

FIG 13

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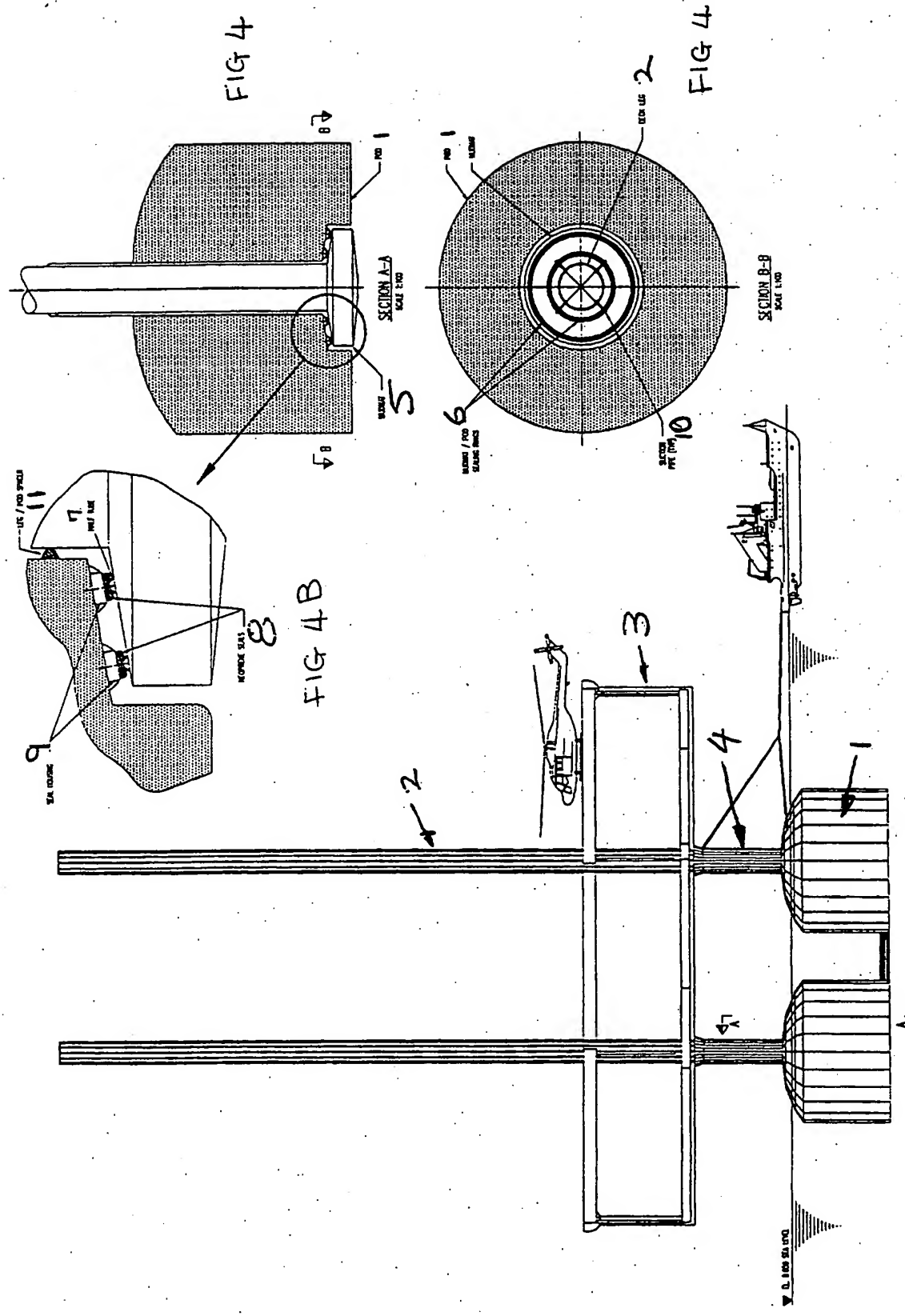

FIG 4

FIG 4A

FIG 4B

FIG 1

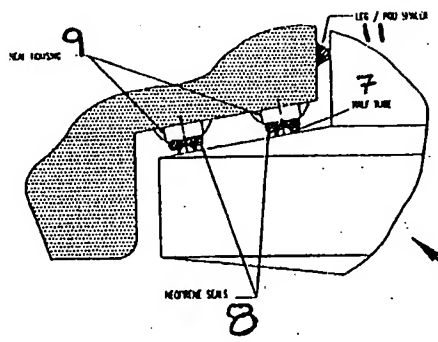

fig 4b

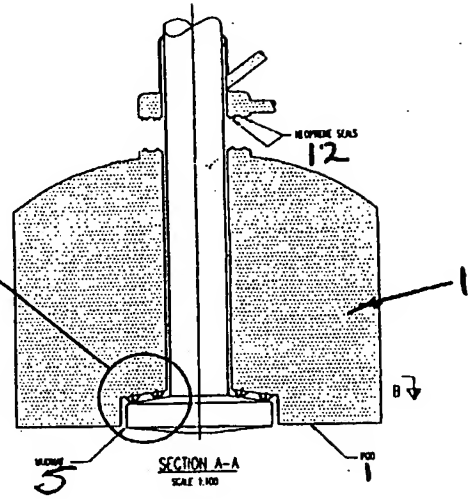

fig 4C

ELEVATION

fig 2

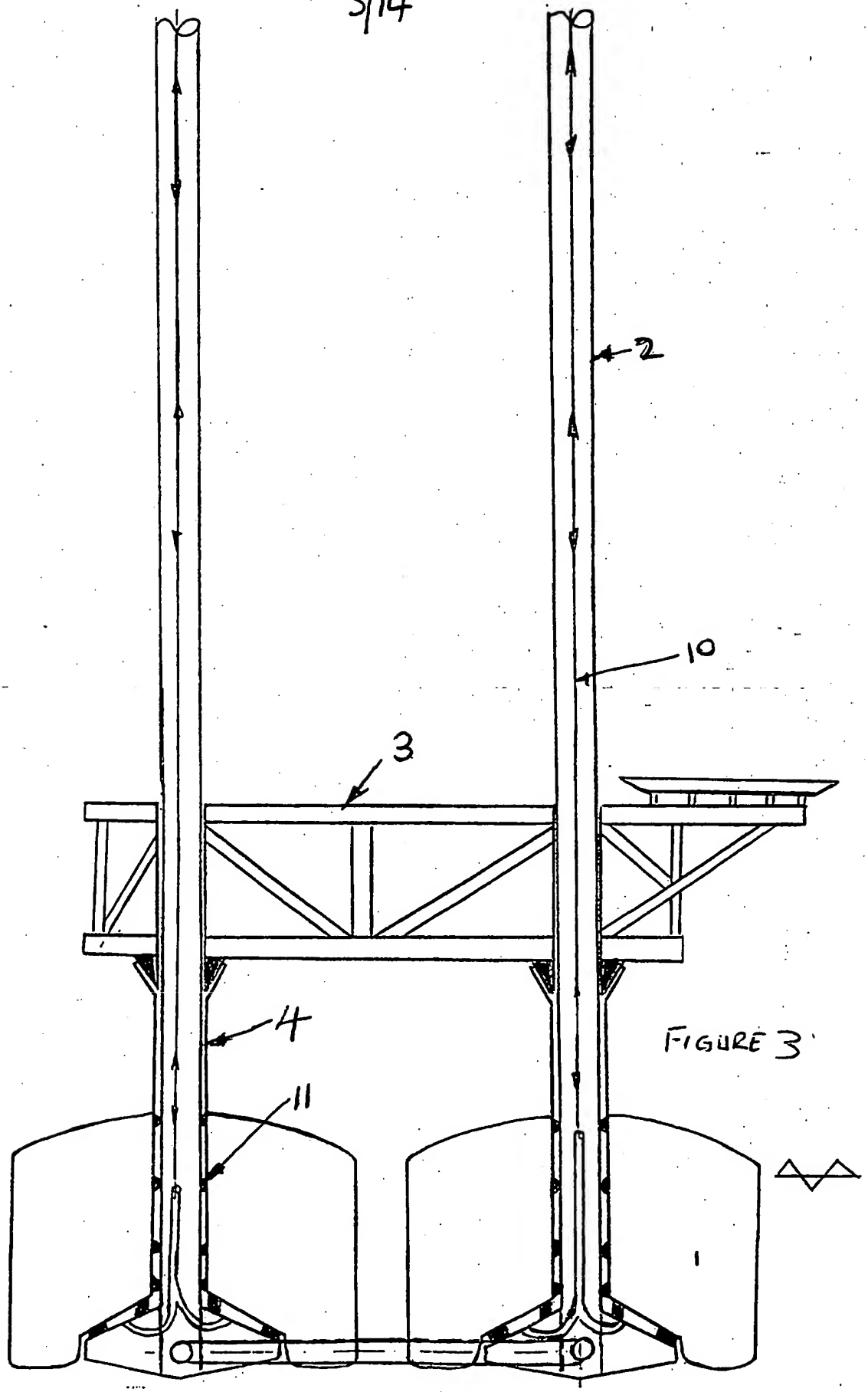

FIGURE 3

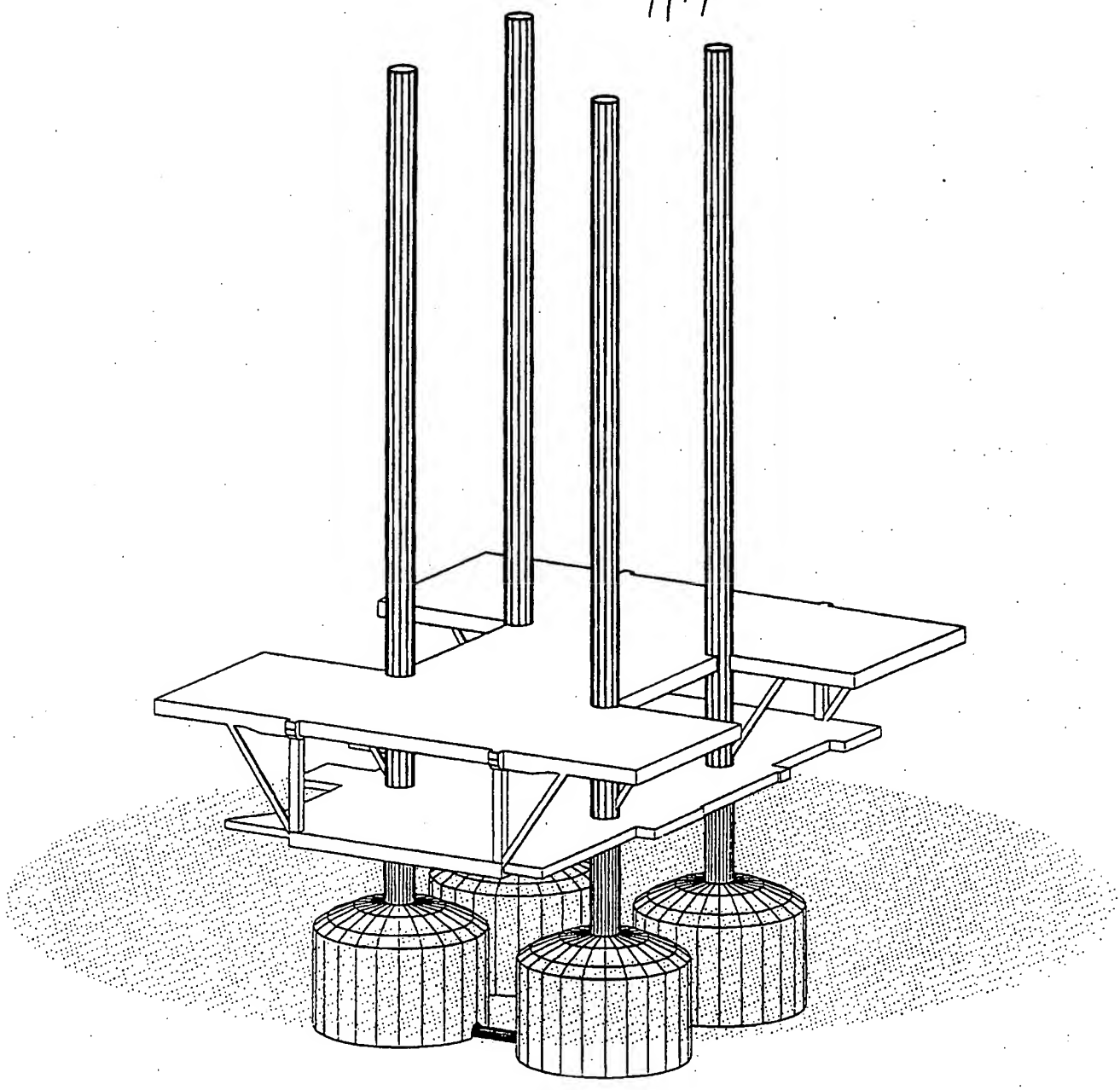

FIG 5

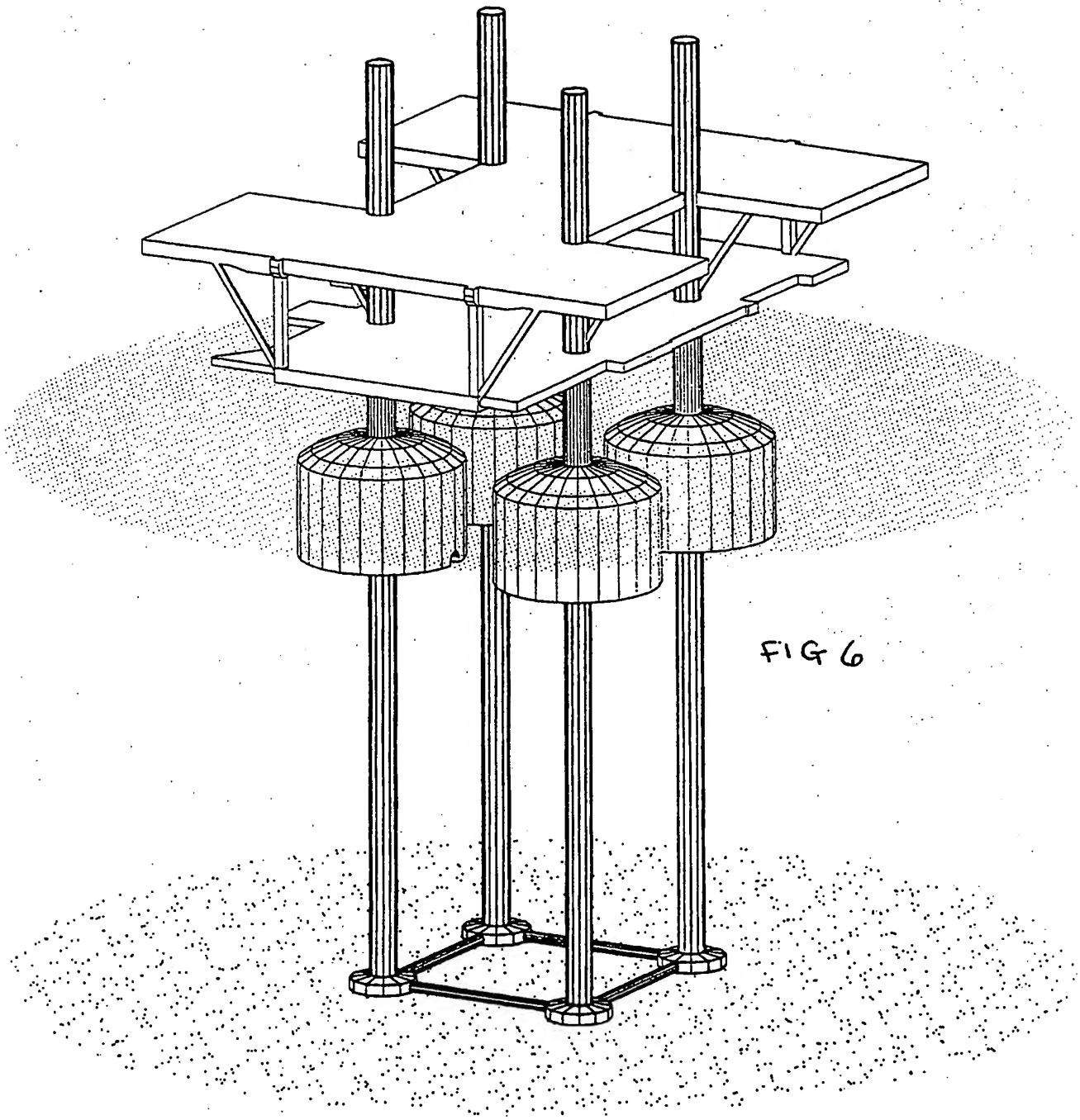

FIG 6

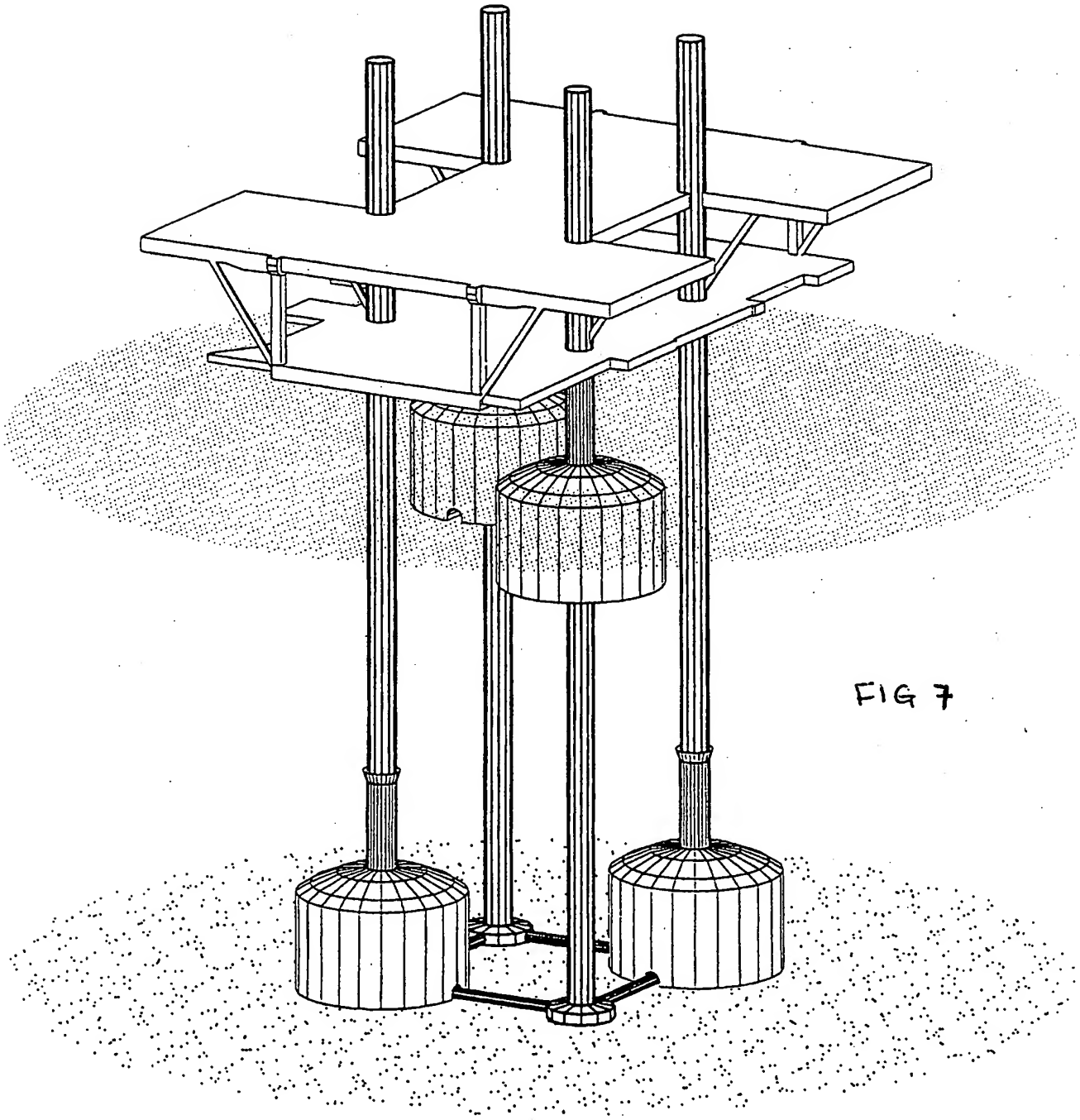

FIG 7

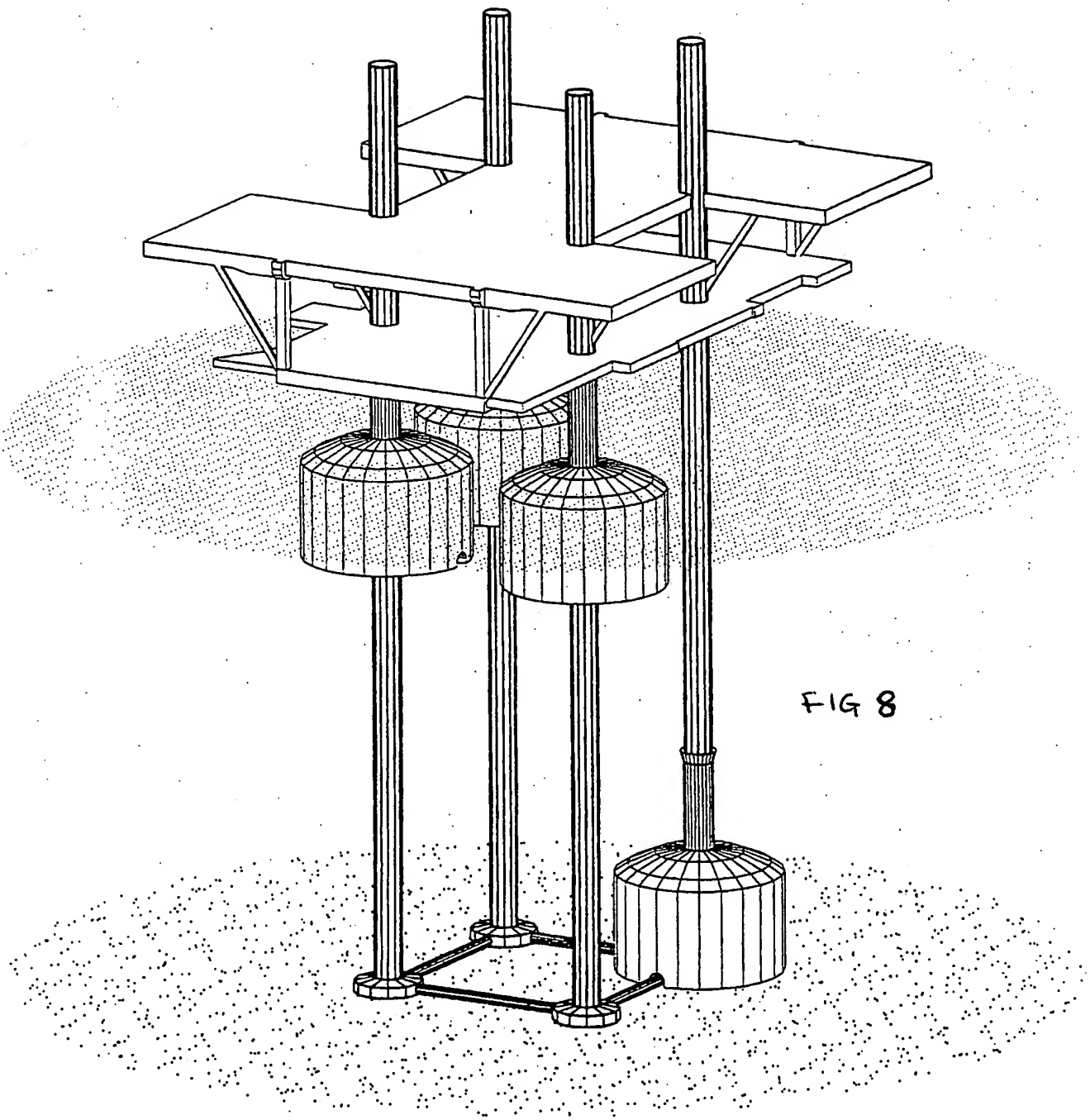

FIG 8

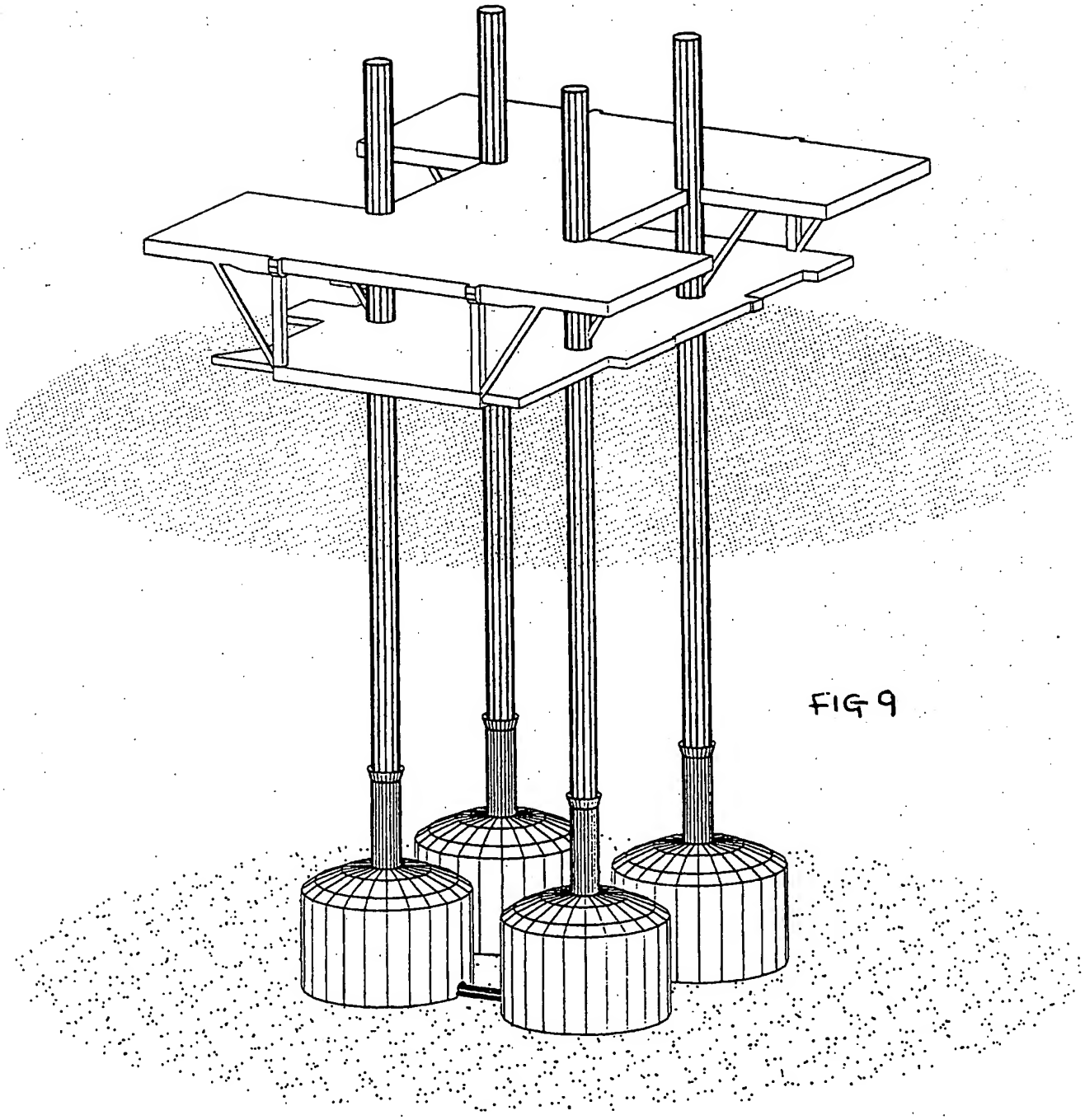

FIG 9

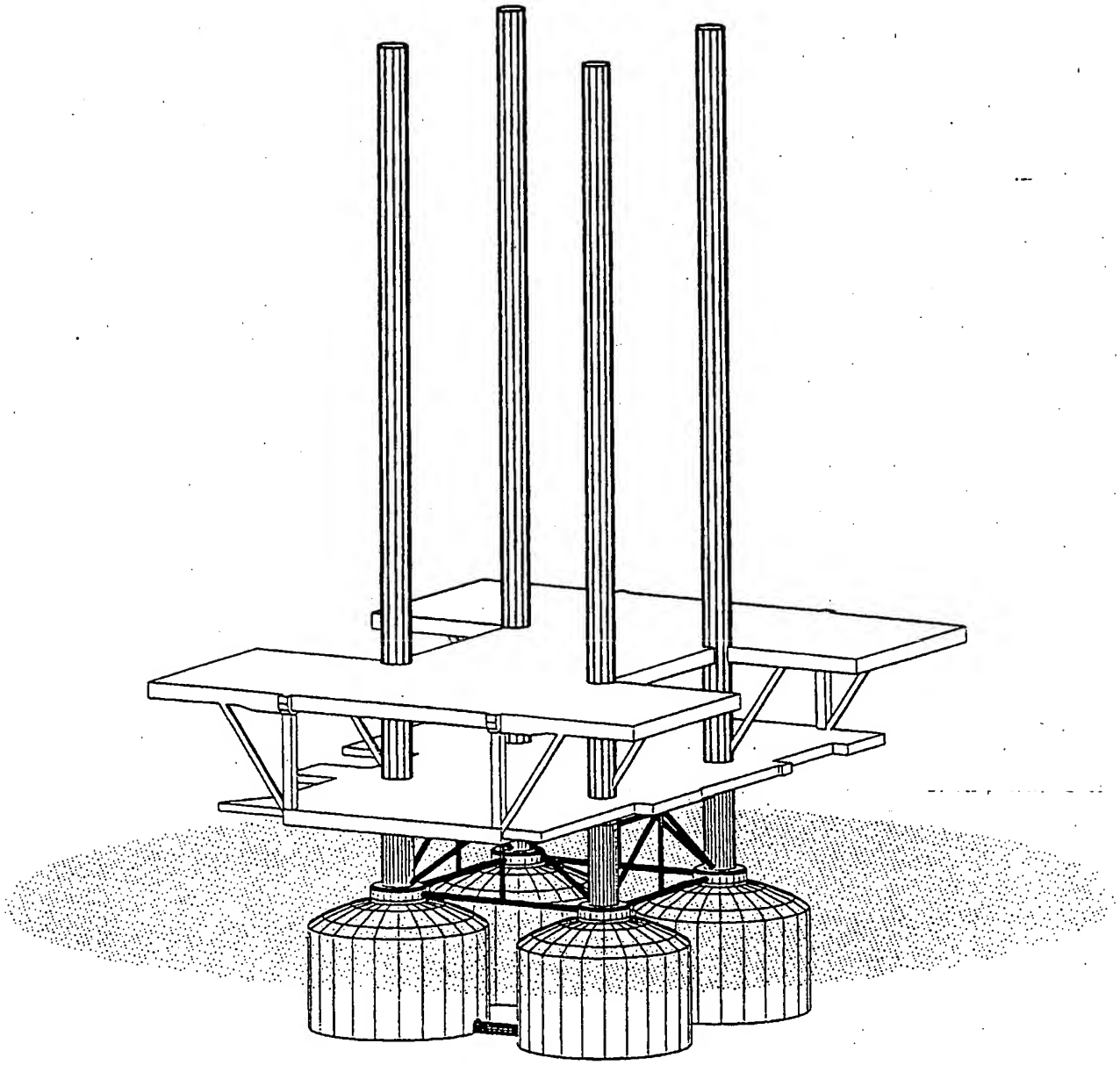

FIG 10

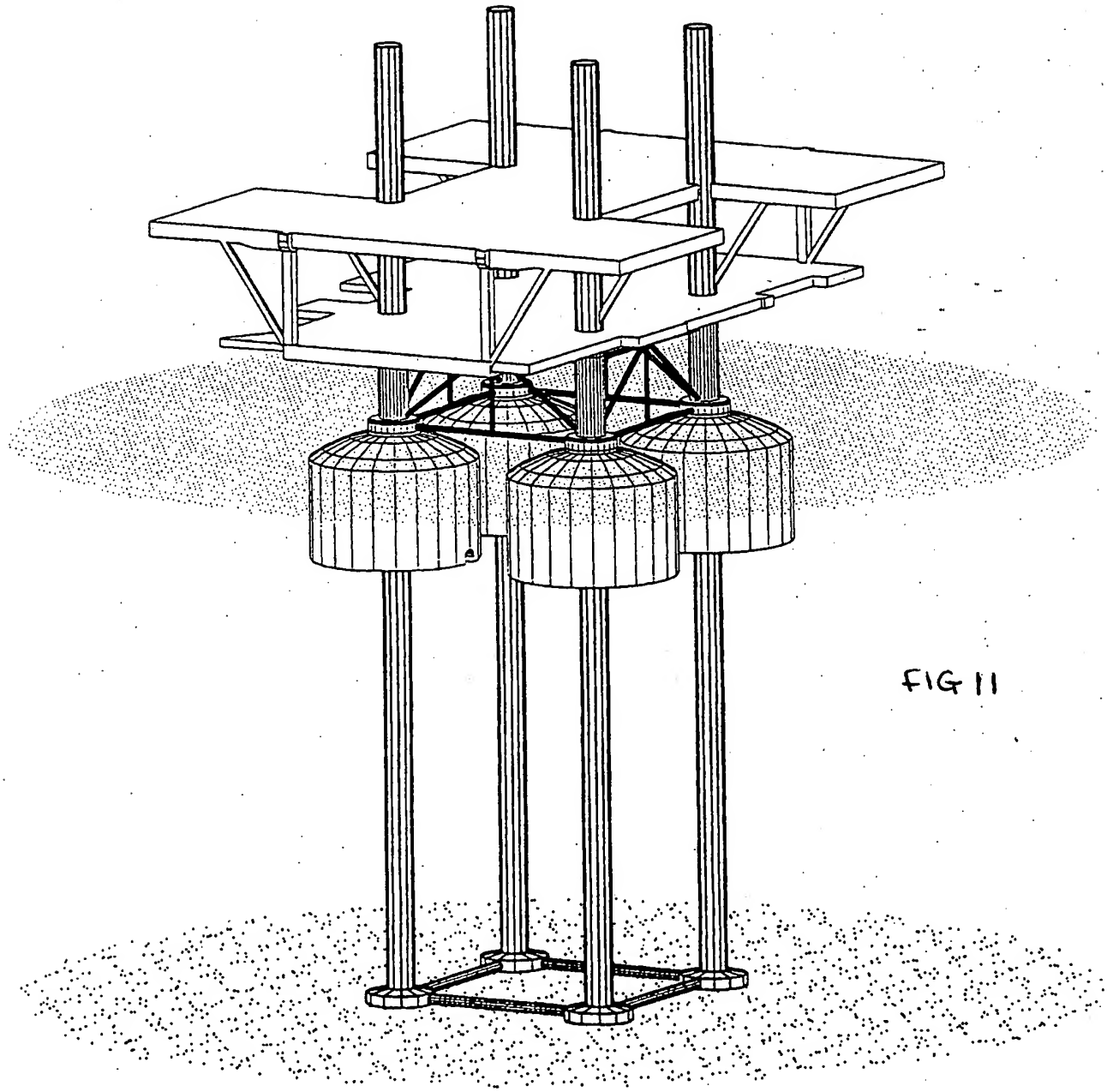

FIG 11

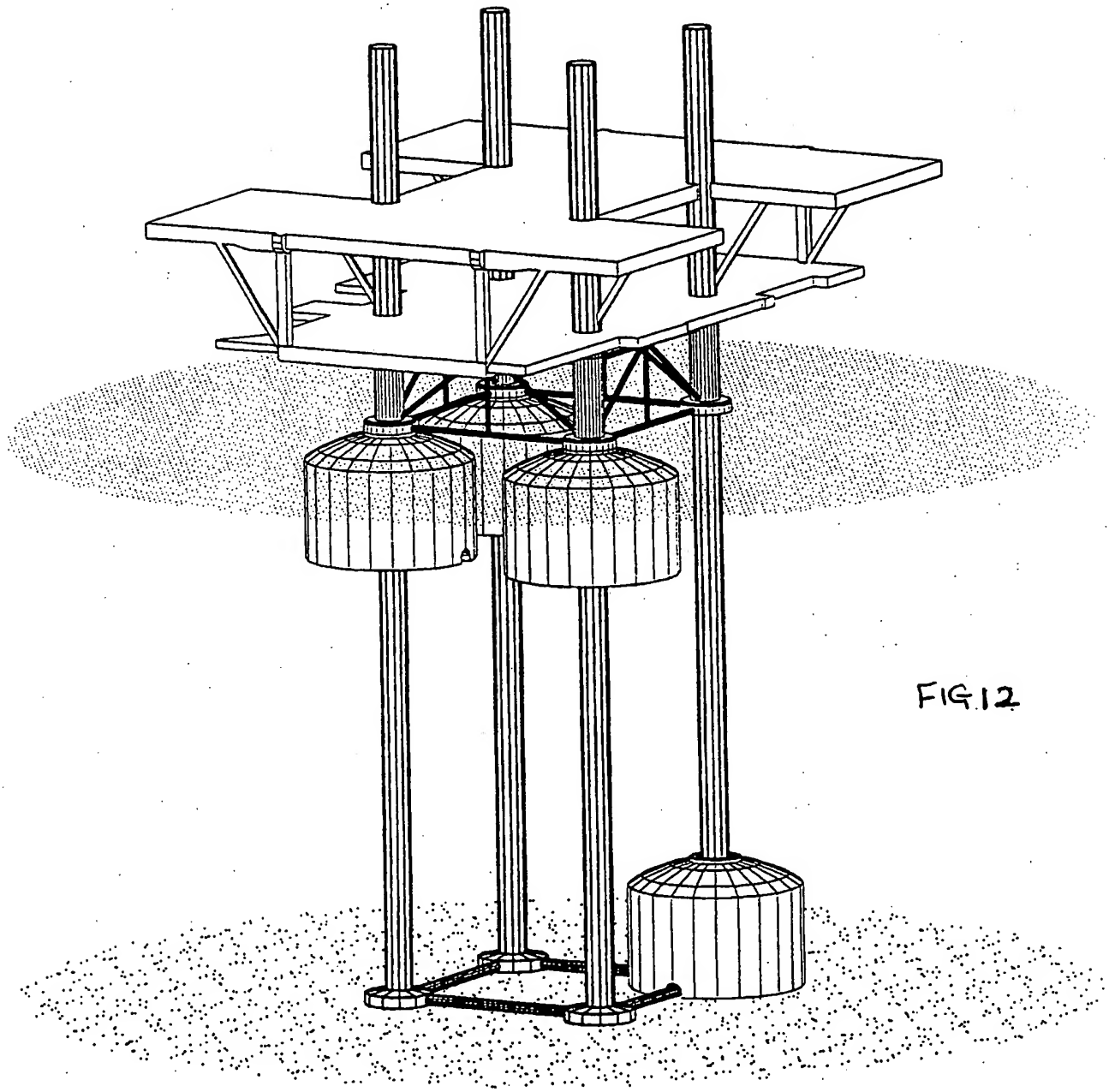

FIG.12

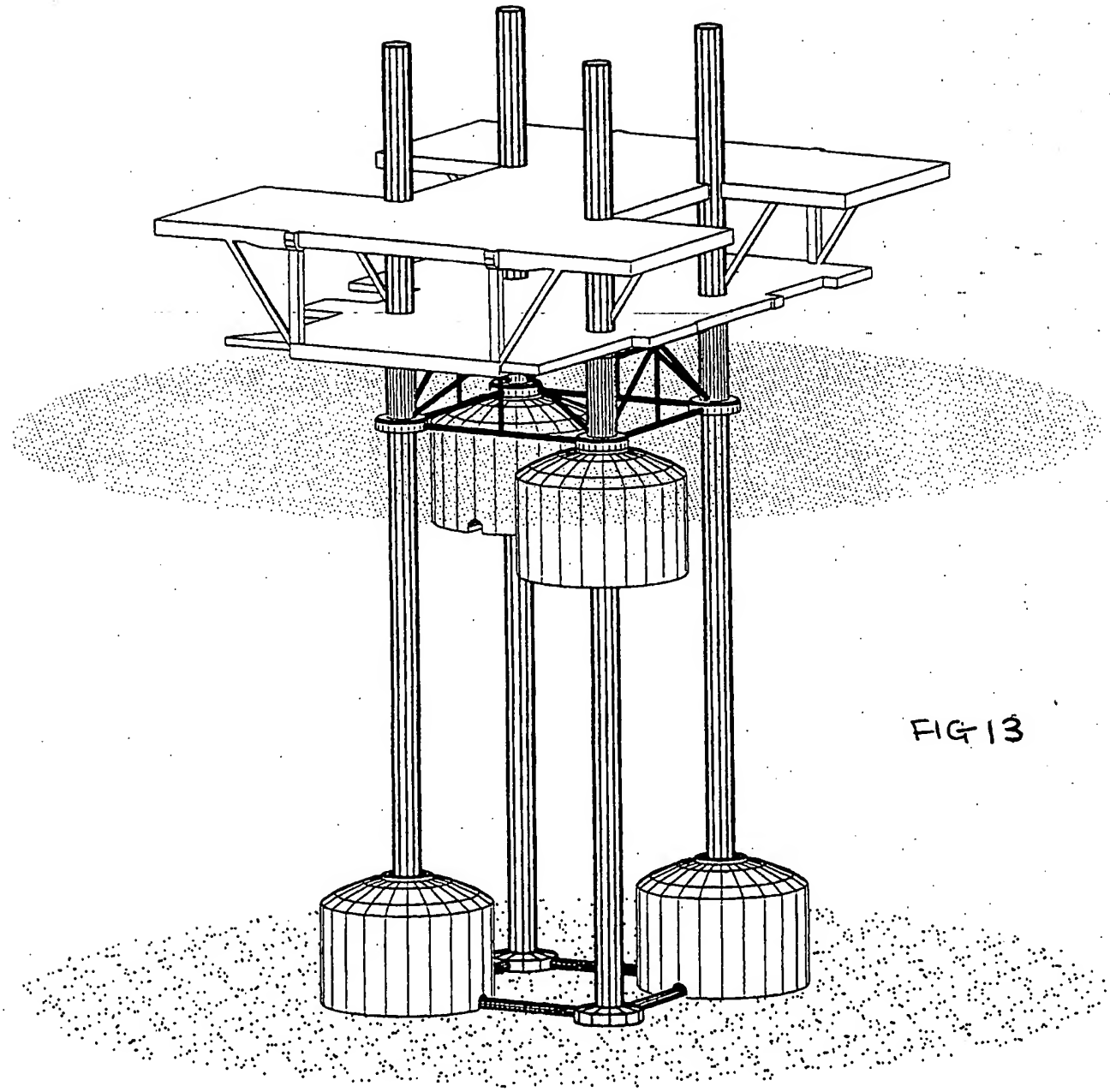

FIG 13

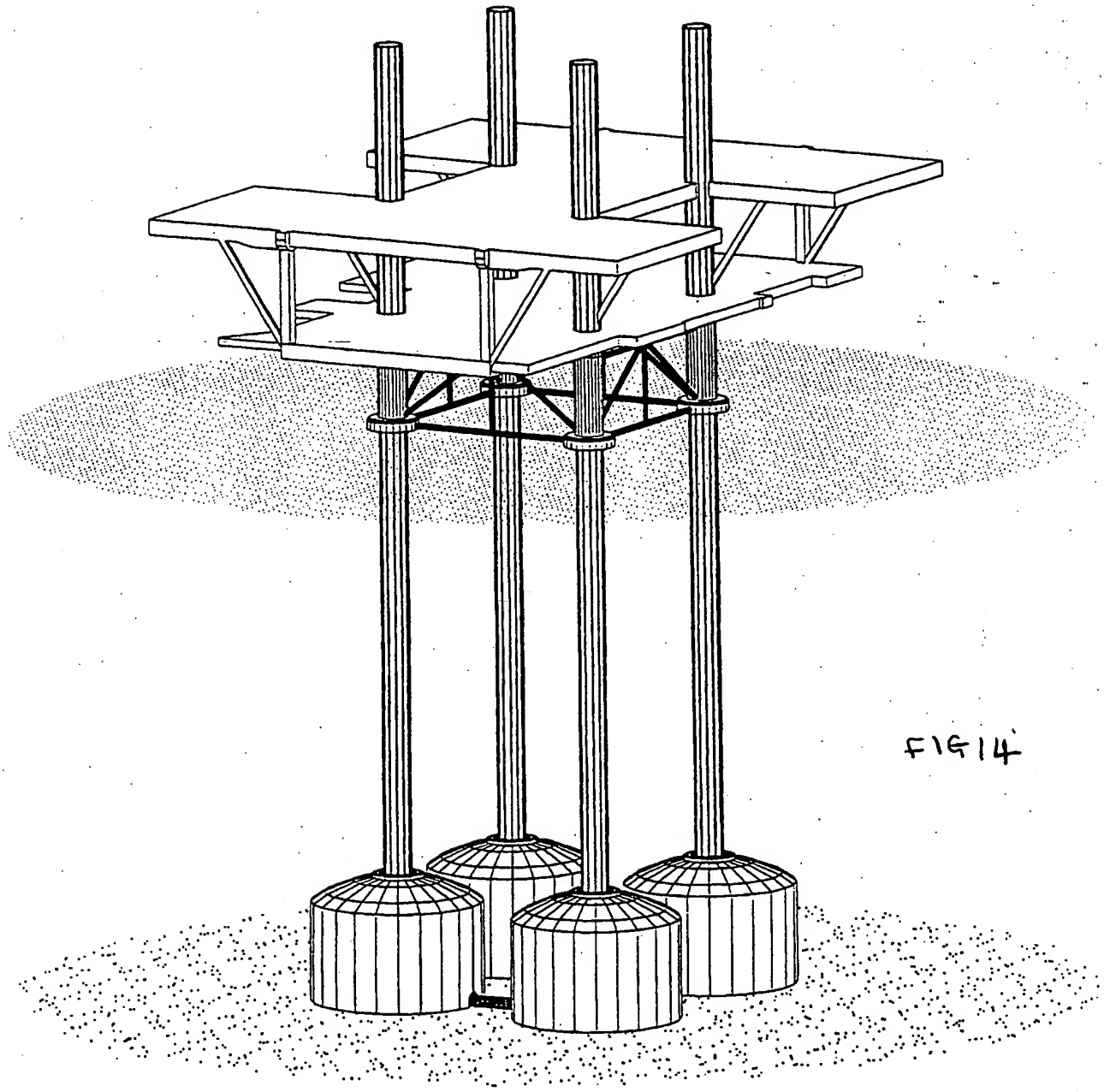

FIG 14

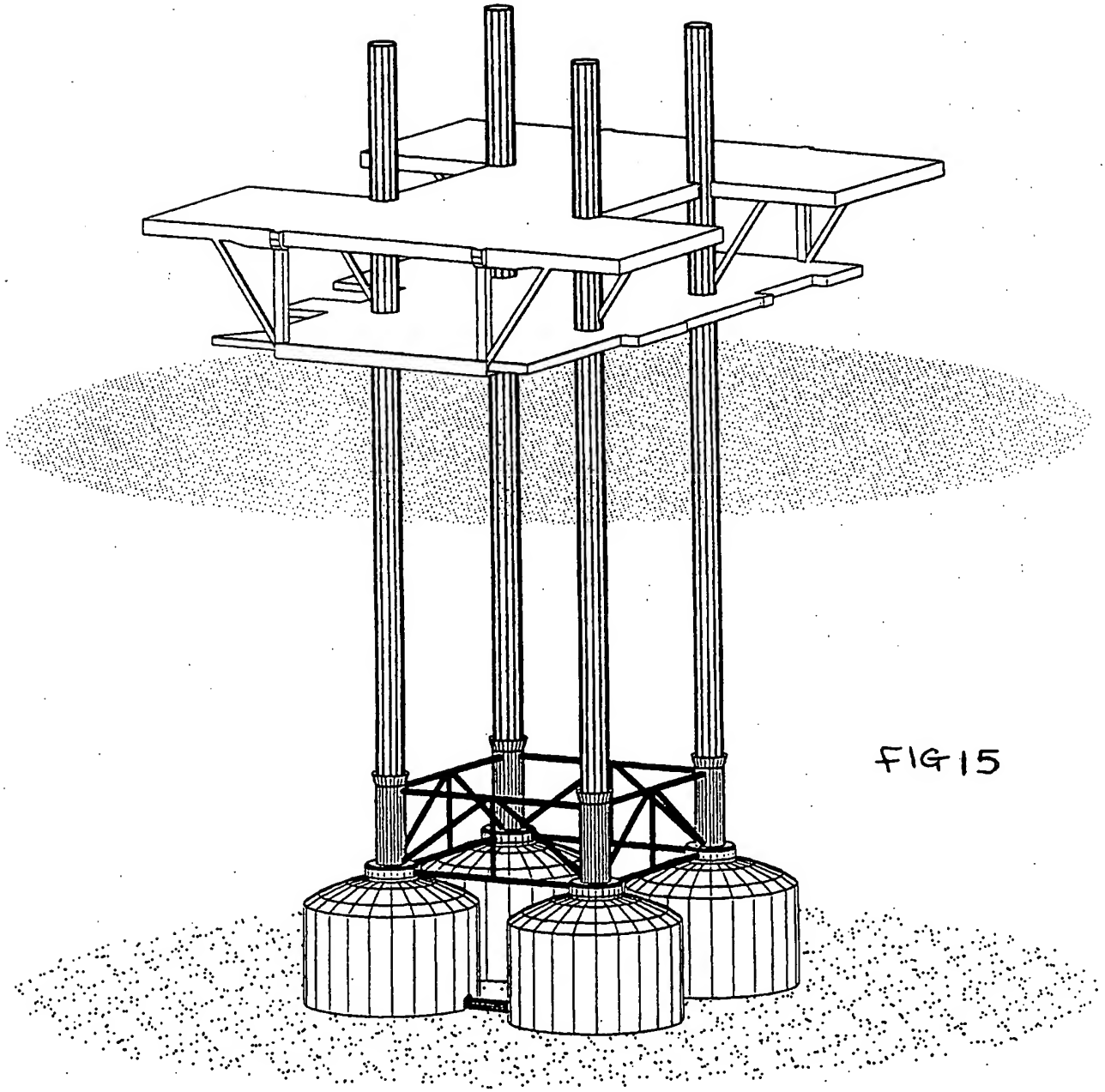

FIG 15

IMPROVED SELF INSTALLING REUSABLE FIXED PLATFORMS

Field of the Invention

This invention relates to Self Installing Reusable Fixed (SIRF) Platforms which are typically used for offshore exploration, drilling and production activities but can also be used as supporting structures for other marine bodies such as the bridges or offshore accommodations. They will have adequate self buoyancy and stability during transportation phases being either self propelled or towed to the location. Once in location they will have the facility to install themselves as fixed marine structures, supported on the sea bed with a gravity foundation.

Background to the invention

There have been a number of developments in this field. The most common being the Jack-Up or Self Elevating Platforms for which the industry classification exist. These are essentially ships with retractable legs. The legs typically 3 or more penetrate through jacking housing in the hull of the ship and they are sufficiently long for the intended water depth. In transit the legs are retracted and stick up in the air with the bottom of the leg tagged under the hull of the vessel. When in location, the legs are lowered to the sea bed and the hull which supports the deck is jacked out of the water to the required height. In that condition, all the weight of the hull, deck, jacking facility, functional and environmental loads are supported by the legs. The foundation at the bottom of the legs are either provided by mud mats designed to sit on the top of the sea bed or spat cans which are designed to penetrate into the soil in order to provide the required foundation characteristics. The spat cans are initially forced down by pre-load tanks in the hull which are filled with water to a pre-determined weight and then emptied. This ensures

that the spat cans would not penetrate the soil excessively under the in service conditions. The mud mats are required to be heavy enough to prevent uplift and by mobilising the bearing and sliding capacities of the soil they are also designed to satisfy the foundation requirements for the compressive as well as the lateral loads. They are designed to sit on top of the sea bed and not to penetrate significantly. Spat cans have been more commonly used because in order to satisfy all the functional and environmental loading, mud mats are found to be too large and because of their size, they are more difficult to lower to or raise from the sea bed. For removal, the hull is jacked down into the sea providing buoyancy and stability to jack the legs up to their transit position. Other variations on this concept have been to have large concrete bases attached to the bottom of the legs providing either all or part of the buoyancy required for transit and when in location they are ballasted to the sea bed and used as mud mat type gravity foundations. The stability and the buoyancy during lowering of the legs are provided by an additional unit which is also used to jack the deck up to the required elevation.

These concepts have the following disadvantages :

- They are expensive, utilising large jacking mechanisms and a hull which is only used during transit and installation and remains redundant during in service conditions.

- The environmental conditions required for deploying or retrieving the legs are restrictive.

- The weight of the hull and the jacks and the extra wind loading on them add extra burden on the legs. This in turn cause the legs to be larger, attracting more wave loading.

- The additional mass concentrated at the top of the installation increases its natural period making it dynamically more responsive to the waves.

- The large mud mats develop suction and stickiness between the mats and the soil, making them difficult to retrieve. The spat cans penetrate into the soil and a large force is required to pull them free.

It is the object of the present invention to overcome or minimise some or all of the above deficiencies.

Summary of the Invention

According to a first aspect of the present invention there is provided a platform assembly of the type in question comprising:-

(i) one or more legs adapted to carry and support a deck assembly, the lowermost in use end of each leg incorporating a mud mat;

(ii) a deck assembly;

(iii) one of more buoyancy elements, each buoyancy element being associates with one of the legs; and

wherein the buoyancy elements are adapted to be independently moveable up and down said respective legs and also independently moveable with respect to the deck assembly.

In this arrangement the buoyancy units can be utilised as a composite hull for transit as well as acting as gravity foundations.

Preferably the buoyancy element(s) are adapted to be lowered to the lowermost in use end of the legs and to encapsulate the mud mats and thus form in combination with the mud mats a foundation for each leg.

In a particularly preferred embodiment the platform assembly incorporates releasable couplings between the bouyancy element(s) and the mud mats.

By having a facility to safely and reliably couple and de-couple the base of the legs which act as small mud mats and the buoyancy element(s) the effect of suction is minimised for ease of retrieval.

Brief Description of the Drawings

The specific embodiment of the innovative Self Installing Reusable Fixed Platform will now be described by way of example only with reference to the accompanying drawings in which :-

Figure 1 shows a side view of the concept in its transit phase;

Figure 2 shows a side view of the concept utilising a truss braced support in its transit phase;

Figure 3 shows a cross section of two legs and pods exposing the internal guide, coupling and support mechanisms;

Figure 4 shows cross sections of a leg and the pod exposing the innovative mechanism used to couple and de-couple the leg from the buoyancy elements which in this text will be referred to as pods;

Figure 4a shows a horizontal cross section giving a view from above showing the sealing arrangement and the suction pipes necessary for the coupling, de-coupling unit.

Figure 4b shows cross sectional side view of a typical sealing arrangement for the coupling, de-coupling unit;

Figure 4c shows cross sections on a leg and the pod exposing the innovative mechanism used to couple and de-couple the leg from the buoyancy elements and the coupling de-coupling mechanism between the bottom of the truss and top of the pod;

Figure 5 to 9 show the installation sequence for a 4 leg installation without the truss bracing;

Figures 10 to 15 show the installation sequence for a 4 leg installation with a truss bracing.

Description of the Preferred Embodiments

Referring to the figure 1, 2, 3, 4, 4a, 4b and 4c the platform consists of pods (1) which provide buoyancy and stability during the transit phase and gravity foundations during the in-service conditions. They support the deck (3) on pillars (4) at a height required for the design operating envelope for the structure. The legs (2) are moveable vertically through the pods and the deck but they can be temporarily sea fastened to the pods or the deck or both during transit. There are a number of industry standard fastening

arrangement which can be used, such as the rack and pinion with brakes, clamps or by welding.

These examples show 4 separate pods and 4 legs but the concept would be equally applicable to any other combination pods and legs, even for one pod and one leg. The legs are also shown as single tubes, but they may need to be trussed towers for deeper water depths. In this example the bottom of the legs are shown to be connected together to ensure that the they do not open out during the installation process. However, this also may not be necessary depending on the bending stiffness of the legs. The structure is either self propelled or towed to the location as shown in figure 1.

Once in location the legs are lowered so that mud mats at the bottom of the legs rest on the sea bed. Part of the leg may be extended further than the mats and or mats may have skirts to provide sliding stability. The pods are then ballasted or de-ballasted so that the bottom of the deck is at the required elevation allowing for the most extreme environmental event and an air gap. The legs on the ground provide added stability whilst the deck is raised or lowered. In some soil conditions it may be necessary to pre-load test the leg mud mats prior to raising or lowering of the deck to ensure that the mats can provide the required support. This test is for the loading conditions for the installation phase only which has the minimum deck weight and does not include for the weight of the disposable items, live loads, functional loads and the extreme environmental loads for which the present day spat cans or mud mats are required to be designed and tested for. The load testing of the leg mud mats in this innovative concept is done by fixing the deck to the legs and then de-ballasting the pods. The pre-load on the mats can be calculated from the weight of the ballast water extracted from the pods and therefore additional pre-load tanks are not required. The advantage of using 4 legs and 4 pods is that when one pod is being lowered or raised the other 3 can be designed to provide all the required support and stability either as foundation or as floating bodies.

This sequence is shown on figures 5 to 9. This is done by firstly lowering one of the pods to the sea bed and coupled with the leg forming a gravity foundation, then the diagonally opposite pod is lowered and coupled with the leg and then the other 2. When a pod has been lowered by ballasting or aided by winches over the small mud mats (5) two seal rings (6) are formed generating a volume between the seal rings, the bottom of the pod and top surface of the mats. This volume is isolated from the effect of the sea pressure. Suction pipes (10) are open to the inside of this enclosure and come up either inside or outside of the legs to the top where the water inside the enclosure can be pumped out utilising facilities on the deck. The water pressure in the enclosure is governed by the height of the water column in these pipes. When this height is reduced by pumping the water out, the pressure inside the enclosure reduces and the external pressure of the sea forces the pod and the mat to couple together. The pods are then further ballasted to the required weight. This is a cheap, simple and reliable way of utilising the pods which would have otherwise been redundant during the in service conditions as mud mat type gravity foundation. The coupling between the legs and the pods is also very easy to monitor by monitoring the pressure inside the enclosure. For retrieval, the pods are deballasted and or aided by winches to a predetermined load, the pressure inside the enclosure is then increased by pumping water in to the suction pipes and the pod and the leg are de-coupled. The middle of the pods are not in contact with the soil and therefore the suction and stickiness between the base of the pod and the soil which would have been more severe towards the middle of the mat is minimised. Retrieval procedure is the opposite of the installation.

Having the buoyancy pods as the foundation utilises them for all the phases of transit, installation, operation and retrieval. It also minimises the loading on the legs as explained above. The biggest weakness in the legs is the tendency to buckle due to

compressive load and for a given size leg this is a function of the unsupported length of the leg. In order to minimise the effect of this, we have utilised a trussed bracing which can be coupled and de-coupled hydraulically as shown 12 in a similar way as explained above for between the pods and the leg mats. In transit, the truss is coupled on top of the pods and supports the deck, the deck being sea fastened to the deck. When all the pods have been installed as explained above, the truss is also lowered on top of the pods and coupled to them. The top of the truss can also be braced in the horizontal direction with guides for any appurtenances which may be required. This shortens the unsupported length of the legs by the height of the pods plus the height of the truss and thereby either reduces their size or increase the operating water depth. This installation procedure is shown in figures 10 to 15. The retrieval sequence being the opposite. One way of providing the sealing ring arrangement has been shown by way of an example. This uses a half tube welded on the top surface of the mats in two circles, one inner and one outer as shown marked (7). There are similar rings on the base of the pods making up the sealing element (8) shaped to cradle around the half tube. The sealing elements can be made of a material such as neoprene and will be supported within the seal housing (9). The spacers (11) between the pod and the leg ensures that the seals engage the half tubes within acceptable tolerances.

The present invention overcomes or minimise some or all of the above identified deficiencies :

1. By not requiring a jacking mechanism,
2. By utilising the hull for transit as well as the gravity foundation without requiring an additional buoyancy unit to make it possible to lower or retrieve the legs or the hull,
3. By having a facility to safely and reliably couple and de-couple the base of the legs which act as small mud mats to the hull which would act as the large mud mats

having the required weight and contact area with the soil to develop the bearing and sliding capacities needed for the in-service conditions and because they can be de-coupled from the leg mud mats, the effect of the suction is minimised for ease of retrieval.

4. By having the facility to lower a truss system over on to the buoyancy pods on the sea bed and coupling them together and thereby reducing the effective length of the legs.

5. By having the facility to lower the hull (pods) in segments so that the installation and retrieval can take place in more severe environmental conditions.

CLAIMS

1. A platform assembly of the type in question comprising:-

(i) one or more legs adapted to carry and support a deck assembly, the lowermost in use end of each leg incorporating a mud mat;

(ii) a deck assembly;

(iii) one or more buoyancy elements, each buoyancy element being able to be ballasted or deballasted and associated with one of the legs; and

wherein each buoyancy element is adapted to be independently moveable up and down the respective leg and also relative to the deck assembly

2. A platform assembly as claimed in claim 1, wherein the or each buoyancy element is adapted to be lowered to the lowermost in use end of the leg and to encapsulate the mud mat and thus form in combination with the mud mat a foundation for the leg.

3. A platform assembly as claimed in claim 1 or claim 2, wherein the platform assembly incorporates a releasable coupling between the or each bouyancy element and mud mat.

4. A platform assembly as claimed in claim 3, wherein the releasable coupling comprises an enclosed volume between the buoyancy element and mud mat with a

suction pipe open to the inside of this enclosure and which pipe comes up either inside or outside of the leg to the top where the water inside the enclosure can be pumped out.

5. A platform assembly as claimed in claim 4, wherein the water pressure in the or each enclosure is governed by the height of the water column in the or each pipe.

6. A platform assembly as claimed in claim 4 or claim 5, wherein the pressure inside the enclosure is monitored.

7. A platform assembly as claimed in any preceding claim, wherein a truss bracing is provided and wherein the truss bracing can be coupled and decoupled hydraulically.

8. A platform assembly as claimed in claim 7, wherein a truss bracing is provided which is adapted to be lowered onto the buoyancy elements(s) on the sea bed and coupled to the buoyancy element(s) by a coupling and decoupling mechanism between the bottom of the bracing truss and the top of the buoyancy element(s).

9. A platform assembly as claimed in any preceding claim, wherein the leg(s) are moveable vertically through the buoyancy element(s) and the deck but can be temporarily sea fastened to the buoyancy element(s) or the deck or both during transit.

10. A platform assembly substantially as hereinbefore described with reference to any suitable combination of the accompanying drawings.

The Patent Office

Application No: GB 9717719.0
Claims searched: 1-10

Examiner: Alan Habbijam
Date of search: 17 December 1998

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.P): E1H (HB,HCA,HEA,HEF) : B7A (AAAQ,AER) : B7V (VAA, V103)

Int Cl (Ed.6): B63B 35/44 : E02B 17/02

Other: Online:WPI,EPODOC,PAJ

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	US 3717001 (TAM) See tank 11 movable up and down legs 18.	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.